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Dielectric elastomers are a promising category of smart materials, which may find application within many fields such as soft robotics, wave-energy harvesting and loud speakers. A dielectric elastomer consists of a thin, stretchable polymer film sandwiched between two compliant electrodes. When an external voltage is applied to the electrodes, an electrostatic pressure across the elastomer is generated, which will cause the electrodes to attract one another. Thereby the thickness of the elastomer is decreased and the cross sectional area of the elastomer is increased. When the voltage is switched off, the elastomer regenerates its original shape.

Several electrical aging mechanisms are known to occur during operation; some cause fast breakdown while others cause slow degradation of the dielectric elastomer. One of the most significant fast aging mechanisms is thermal breakdown. Thermal breakdown initiates when the heat produced within the elastomer, mainly joule heating, exceeds the heat loss to the surroundings. This may be either locally or macroscopically.

We strive to enhance the understanding of thermal breakdown in dielectric elastomer by performing numerical simulation of the actuation of dielectric elastomer transducers in stacked configuration, an example of such a simulation is shown in Figure 1. Multiple simulations using experimental data for PDMS have been performed using COMSOL Multiphysics, from which the key parameters affecting thermal breakdown have been identified. In this presentation we will present the findings and identify the optimal operating conditions for a PDMS dielectric elastomer in order to minimize thermal breakdown

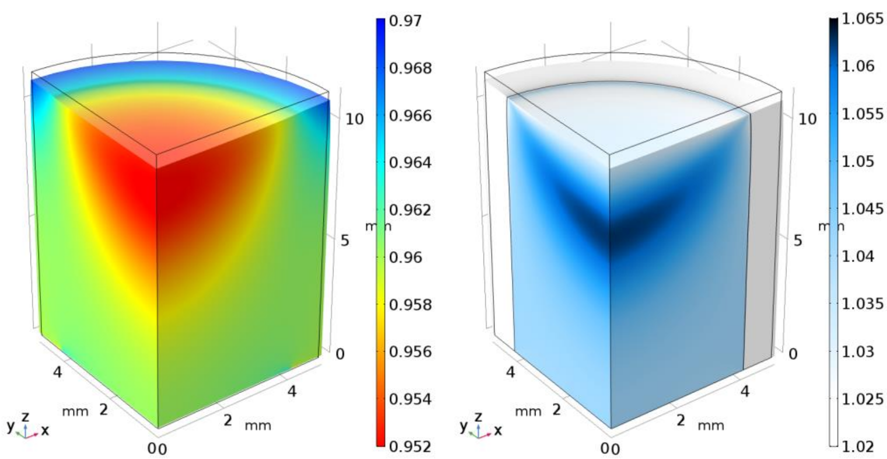

Figure 1: Simulation results from a simulation of a stack of 450 dielectric elastomers. The electrodes are applied in the middle of the stack covering 64% of the total area. The picture to the left displays the stretch ratio in the z-direction, and the ratio of the normalized electric field to the initial electric field is displayed on the picture to the right.